MODEL

ID-1590 / ID-1590E Digital Wind Speed / Direction Indicator

HEATHKIT®

ASSEMBLY MANUAL

HEATHKIT

PRICE $2.00

Edward O. Malott
54 Tamarack Way
Pleasantville, N. Y. 10570

595-1797

Dear Customer:

The Heathkit electronic product you have purchased is one of the best performing electronic products in the world.

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During your first 90 days of ownership, any parts which we find are defective, either in materials or workmanship, will be replaced or repaired free of charge. And we'll pay shipping charges to get those parts to you — anywhere in the world.

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Sincerely,

HEATH COMPANY
Benton Harbor, Michigan 49022

Prices and specifications subject to change without notice.

Assembly and Operation of the

HEATHKIT

DIGITAL WIND SPEED/ DIRECTION INDICATOR

MODEL ID-1590/ ID-1590E

Serial # 00534

TABLE OF CONTENTS

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

Printed in U.S.A.

RECEIVER TESTS AND ADJUSTMENTS

If you do not get the indicated results as you perform each test, refer to the boxed "Possible Cause Chart" which follows. If none of the difficulties listed in the chart is the cause of the malfunction, refer to the appropriate part of the "In Case of Difficulty" section. If you have a difficulty, DO NOT proceed until it has been corrected since, in some cases, the difficulty may cause further damage.

Refer to Figure 1-1 (in the "Illustration Booklet") for the display circuit board lamp locations and to Figure 1-2 (in the "Illustration Booklet") for rear panel connections and switches.

Refer to Figure 1-5 to identify controls mounted on the main circuit board.

( ) Place the CAL-NORM switch on the rear panel in the NORM position.

( ) Adjust circuit board controls R217 and R221 to their center of rotation.

( ) Connect the line cord plug to an appropriate AC outlet.

WARNING: High voltage is present at several locations in the Indicator. See Figure 1-5.

( ) Refer to the chart below to determine which lamps should be lit for the wiring option you selected on Page 11.

Wiring option.	Lamp lit with Display. Select switch up.	Lamp lit with Display Select switch down.
#1	L9	L10
#2	L10	L11
#3	L9	L11

Possible Cause Chart
1. Lamps do not light in either switch position. A. Fuse. B. Wiring at 3-lug terminal strip. C. Transformer T1. D. Resistor R205.
2. Incorrect lamp lights. A. Wiring associated with Display Select switch.
3. Only one lamp lights. A. Display Select switch wiring. B. Associated lamp.

( ) Unplug the line cord.

( ) Refer to Figure 1-2 and temporarily solder the banded end of a 1N2071 diode (#57-27) to a 10" wire left over from the step-by-step assembly.

( ) Connect the free end of the wire to the BLU/BLK screw terminal on the cabinet back.

( ) Plug in the line cord.

( ) Refer to the chart on the next page and, in sequence, touch the unbanded end of the diode to the corresponding terminal in the "Terminal" column. The lamp listed in the "Lamp Lit" column should light up.

Terminal	Lamp Lit
BRN	#7 SE
WHT	#5 X SW
GRN	#3 X NW
RED	#1 NE

Possible Cause Chart
1. No lamps light. A. Test diode. B. Resistor R1.
2. Lamps #7 does not light. A. Diode D7. B. Lamp L7.
3. Lamp #5 does not light. A. Diode D5. B. Lamp L5.
4. Lamp #3 does not light. A. Diode D3. B. Lamp L3.
5. Lamp #1 does not light. A. Diode D1. B. Lamp L1.

( ) Unplug the line cord.

( ) Reverse the connection at the BLU/BLK terminal so the unbanded end of the diode is connected to the BLU/BLK terminal.

( ) Plug in the line cord.

( ) Refer to the chart below and touch the banded end of the diode to each terminal in sequence. The lamp listed in the "Lamp Lit" column should light.

Terminal	Lamp Lit
BRN	#8 E
WHT	#6 S
GRN	#4 W
RED	#2 N

Possible Cause Chart
1. Lamp #8 does not light. A. Diode D8. B. Lamp L8.
2. Lamp #6 does not light. A. Diode D6. B. Lamp L6.
3. Lamp #4 does not light. A. Diode D6. B. Lamp L6.
4. Lamp #2 does not light. A. Diode D2. B. Lamp L2.

( ) Unplug the line cord.

( ) Unsolder and remove the diode from the test wire.

( ) Again, connect the 10" test wire to the BLU/BLK terminal.

( ) Refer to Figure 1-4 (in the "Illustration Booklet") and install DD700/DM8880 integrated circuits (#443-602) at IC208 and IC209.

( ) Plug in the line cord. Two F's should be displayed on readout tube V1.

Possible Cause Chart	
1.	V1 does not light.
	A. Display tube V1.
	B. Transistors Q201 or Q202.
	C. Diodes D201, D202, D203, or ZD201.
	D. Transformer T1.
	E. Resistor R201.
2.	Incorrect display.
	A. Wiring between main and display circuit boards.
	B. IC208 or IC209.
3.	Incorrect display in right digit only.
	A. IC208.
	B. Resistor R225.
4.	Incorrect display in left digit only.
	A. IC209.
	B. Resistor R224.

( ) Refer to the chart below and touch the indicated pins of IC208 and IC209 with the test wire connected to the BLU/BLK terminal. The correct results are listed in the "Proper Output" column for each IC. See Figure 1-3 (in the "Illustration Booklet") for pin locations.

Pin Number	Proper Output IC208	Proper Output IC209
1	Fd	dF
2	Fb	bF
6	F7	7F
7	FE	EF

Possible Cause Chart	
1.	Improper display.
	A. IC208 or IC209.
	B. IC improperly installed.
	C. Poor connections Associated with the IC.

( ) Unplug the line cord.

( ) Again refer to Figure 1-4 (in the "Illustration Booklet") and install SN7475 integrated circuits (#443-13) at IC206 and IC207.

( ) Plug in the line cord. Two F's should be displayed on readout tube V1.

( ) Refer to the chart below and touch the indicated pins of IC206 and IC207 with the test wire. The correct results are listed in the "Proper Output" column for each IC.

Pin Number	Proper Output IC206	Proper Output IC207
2	Fd	dF
3	Fb	bF
6	F7	7F
7	FE	EF

Possible Cause Chart	
1.	Improper display.
	A. IC206 or IC207.
	B. IC improperly installed.
	C. Poor connections associated with the IC.

( ) Unplug the line cord.

( ) Refer to Figure 1-4 and install SN7490 integrated circuits (#443-7) at IC204 and IC205.

( ) Plug in the line cord. A zero should be displayed on readout tube V1.

Possible Cause Chart	
1.	Improper display.
	A. IC204 or IC205.
	B. IC improperly installed.
	C. Poor connections associated with the IC.

( ) Unplug the line cord.

( ) Remove and save the test wire from the BLU/BLK terminal.

Refer to Figure 1-4 for the next two step.

( ) Install an SN7400 integrated circuit (#443-1) at IC202.

( ) Install an SN74121N integrated circuit (#443-22) at IC203.

( ) Plug in the line cord and allow the display to reset to zero.

( ) Temporarily touch the test wire between IC203, pin 6 and IC208, pin 5. The displayed zero should flash on and off.

Possible Cause Chart	
1.	Zero does not flash on and off.
	A. IC202 or IC203.
	B. Transistor Q203.
	C. Poor connections associated with the IC.

( ) Unplug the line cord.

( ) Place the DISPLAY SELECT switch in the up position.

( ) Refer to Figure 1-4 and install an SN74123 integrated circuit (#443-90) at IC201.

( ) Plug in the line cord and allow the display to reset to zero.

Possible Cause Chart	
1.	Display reads something other than zero.
	A. NORM-CAL switch.
	B. Switch wiring errors.

( ) Place the NORM-CAL switch, on the cabinet back, in the CAL position. A number other than zero should appear on the display tube.

Possible Cause Chart	
1.	Display reads zero.
	A. Transformer T1.
	B. Resistor R204 or R206.
	C. IC201 or IC202.
	D. NORM-CAL switch.

( ) Note the position of the DISPLAY SELECT switch on the cabinet back. Then refer to the following chart and adjust the appropriate control for the correct display.

EXAMPLE: The Indicator has been wired for Wiring Option #2 (MILES/HR, KM/HR) and will be operated from a 60 Hz power source. You will adjust control R221 for a display of 50 to 51, with the DISPLAY SELECT switch in the MILES/HR position. Then, change the switch position to KM/HR and adjust control R217 for a display of 80 to 81.

Wiring Option	Control	Display	
		60 Hz line	50 Hz line
#1 KNOTS MILES/HR	R221 R217	43-44 50-51	36-37 41-42
#2 MILES/HR KM/HR	R221 R217	50-51 80-81	41-42 67-68
#3 KNOTS KM/HR	R221 R217	43-44 80-81	36-37 67-68

( ) Return the NORM-CAL switch to the NORM position.

( ) Unplug the line cord.

This completes the "Receiver Tests and Adjustments." Proceed to "Receiver Final Assembly."

IN CASE OF DIFFICULTY

Begin your search for any trouble that occurs after assembly by carefully following the steps listed below in the "Visual Tests." After you complete the "Visual Tests," refer to the Troubleshooting Chart.

NOTE: Refer to the "Circuit Board X-Ray Views" on Page 60 for the physical location of parts on the circuit board.

VISUAL TESTS

1. Recheck the wiring. Trace each wire in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the kit builder.

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the "Soldering" section of the "Kit Builders Guide." Be sure there are no solder "bridges" between circuit board foils.

3. Check to be sure that all transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point. Make sure that each diode band is positioned above the band printed on the circuit board.

4. Check the values of the parts. Be sure in each step that the proper part has been wired into the circuit, as shown in the Pictorial diagrams. It would be easy, for example, to install a 27 kΩ (red-violet-orange) resistor where a 2.7 Ω (red-violet-gold) resistor should have been installed.

5. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the unit.

6. A review of the "Circuit Description" may also help you determine where the trouble is.

If you still do not locate the trouble after you complete the "Visual Tests," and a voltmeter is available, check voltage readings against those shown on the "Schematic Diagram" on a fold-in and on the Voltage Chart on Page 59. Read the "Precautions for Troubleshooting" before you make any measurements. NOTE: All voltage readings were taken with a high input impedance voltmeter.

Voltages may vary as much as ±20%. The minus or BLU/BLK terminal on the receiver screw terminal is a convenient ground point.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.

PRECAUTIONS FOR TROUBLESHOOTING

1. Be cautious when testing transistor circuits. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than tubes.

2. Be sure you do not short any terminals to ground when you make voltage measurements. If the voltmeter probe should slip, for example, and short across components or voltage sources, it is very likely to cause damage to one or more transistors or diodes.

SILICON BIPOLAR TRANSISTOR CHECKING

To check a transistor accurately, you should use a transistor checker. However, if one is not available, you can use an ohmmeter to determine the general condition of the transistors in this kit. The ohmmeter you use must have at least 1 volt DC at the probe tip to exceed the threshold of the diode junctions on the transistor being tested. Most vacuum tube voltmeters meet this requirement.

To check a transistor with an ohmmeter, proceed as follows:

1. Remove the transistor from the circuit.

2. Set the ohmmeter on the RX1000 range.

3. Connect one of the ohmmeter test leads to the base (B) of the transistor. Touch the other meter lead to the emitter (E) and then to the collector (C). Both readings should be approximately the same, but may be either high or low. If one reading is high and the other low, the transistor should be replaced. (Identify the transistor leads on the Identification Chart on Page 58.)

4. Repeat step 3 with the test lead reversed.

5. Check the resistance from the collector to the emitter to make sure there is not short circuit.

NOTE: In the unusual case when the readings are low, or all high, no matter which ohmmeter lead is connected to the base, the transistor should be replaced.

Troubleshooting Chart

This chart lists the "Condition" and the "Possible Cause" of a number of malfunctions. If a particular part is mentioned (for example, "Q2") as a possible cause, check that part and the parts connected to it to make sure they are correctly connected and installed. Also make sure that the correct part was installed at that point.

Condition	Possible Cause
L1 only does not light.	L1; D1; S101.
L2 only does not light.	L2; D2; S102.
L3 only does not light.	L3; D3; S103.
L4 only does not light.	L4; D4; S104.
L5 only does not light.	L5; D5; S105.
L6 only does not light.	L6; D6; S106.
L7 only does not light.	L7; D7; S107.
L8 only does not light.	L8; D8; S108.
L1, L3, L5, and L7 do not light.	D102.
L2, L4, L6, and L8 do not light.	D101.
No Wind Direction lights.	R1; open black wire.

Troubleshooting Chart (cont'd.)

CONDITION	POSSIBLE CAUSE
No lights on display circuit board.	Fuse; T1; line cord.
No light on Wind Speed display tube, V1.	V1; D201; D202; R201; T1; Q202; ZD201; D203; IC208; R225.
L9, L10, or L11 does not light	L9, L10, or L11; S2; R205.
Defective "units" (right) digit on display tube V1.	IC204; IC206; IC208. V1
Defective "tens" (left) digit on display tube V1.	IC205; IC207; IC209. V1
No wind speed; calibration checks OK.	S201; S1; open yellow wire.
No wind speed; no calibration readout.	IC201; IC202; R206; D204; D205.
Wind speed display is erratic.	C203; IC201; C208; C209.
Wind speed indicates but will not calibrate in either position of Display Select switch.	C206; C211; IC203; IC202; Q203; C201; Q201; Q202; ZD201.
Wind speed indicates but will not calibrate when Display Select switch is in the UP position.	R217; R218.
Wind speed indicates but will not calibrate when Display Select switch is in the DOWN position.	R219; R221.

SPECIFICATIONS

Wind Speed	0-99 mph, ±1 digit or ±10%.
Wind Direction	8-point readout over 360° with 16 points of resolution.
Wind Speed Sensitivity	3 mph, 4 km/hr, or 2 knots.
Display Rate	Approximately 1.0 second.
Operating Temperature	Receiver: 0° to +150°F. Transmitter: –40° to +150°F.
Primary Controls	Calibrate-Normal switch
Secondary Controls	Two Wind calibrate controls.
Power Requirements	
ID-1590	108-132 VAC, 50/60 Hz, 6.5 watts.
ID-1590E	216-264 VAC, 50/60 Hz, 6.5 watts.
Dimensions	Receiver: 7" wide x 5" deep x 2-1/2" high. Receiver: 17.8 cm wide x 12.7 cm deep x 6.4 cm high.
Net Weight	3-3/4 lbs. 1.7 kg.
Sender/Receiver Separation	Up to 300' of 8 conductor cable.

The Heath Company reserves the right to discontinue products and to change any specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to Figures 6 and 7 and to the Schematic Diagram (in the "Illustration Booklet") while you read this Circuit Description.

WIND DIRECTION (Figure 6)

Reed switches S101 through S108 are actuated by a permanent magnet which is connected to the revolving shaft of the weather vane. The magnet will close any one switch (or two adjacent switches) and light the corresponding lamps, L1 through L8, on the display circuit board. When switch S101 is closed, a circuit is completed through current limiting resistor R1, diode D1, lamp L1, the red cable wire, switch S101, diode D102, and the black cable wire. Therefore, lamp L1 lights. Diode D2 is installed opposite diode D1. Therefore, lamp L2 cannot light. If switch S102 is closed at the same time as S101, current will also flow through diodes D2 and D102, and lamp L2 also lights.

WIND SPEED

Reed switch S201 is actuated by four permanent magnets attached to the rotating shaft of the wind speed sender. The rate at which the switch opens and closes depends on the speed of the wind.

The signal from S201 is converted into a series of constant width pulses whose frequency varies with the wind speed. The series of pulses are sampled and counted for a preset length of time which corresponds to the desired readout (MPH, KNOTS, or KILOM/HR). This information is held in memory latches and displayed at a rate that is easy to read. The input signal is coupled through the yellow cable wire, the CAL-NORM switch (S1), and R206 to IC201. R206 and C203 suppress any noise or switch contact bounce that may be present on the input signal. D204 and D205 provide further protection of the input to IC201.

FREQUENCY DOUBLER

IC201 and section D of IC202 are used as a frequency doubler. IC201 contains two monostable multivibrators. Multivibrator #1 is triggered by the leading edge of the input pulse (Waveform A of Figure 7) while Multivibrator #2 is triggered by the trailing edge.

Each pulse present at the output (pin 4) of multivibrator #1 (Waveform B) is generated by a leading edge of the input signal. The width of this output pulse is determined by R209 and C204. The pulse width is set at approximately 2 milliseconds. Each pulse present at the output (pin 12) of multivibrator #2 (Waveform C) is generated by a trailing edge of the input signal. The width of this output pulse is determined by R211 and C205. This pulse width is also set at approximately 2 milliseconds. C208 and the output of multivibrator #2 are connected to the clear input (pin 3) of multivibrator #1. Likewise, C209 and the output of multivibrator #1 are connected to the clear input (pin 11) of multivibrator #2. This insures positive triggering of each multivibrator. The two output signals from IC201 are applied to the inputs (pins 9 and 10) of IC202D. A positive output pulse is produced by IC202D each time a negative pulse is applied to either input (Waveform D).

This series of constant width pulses, whose frequency is determined by the wind speed, is applied to one input (pin 12) of sample gate IC202E. The series of pulses from the input cannot pass through this gate to the decade counters until a positive voltage is present at its other intput (pin 13). The positive voltage (Waveform H) is provided by the Wind Calibrate Monostable, IC203. The amount of time that a positive voltage is present at pin 13 of IC202E determines the number of pulses to be counted by the decade counters. IC203 is started by the display rate clock, Q203.

DISPLAY RATE CLOCK

C206 is charged at a rate determined by the value of R212 and then rapidly discharges when Q203 conducts. After C206 discharges, Q203 turns off and C206 begins to charge again through R212.

Transistor Q203 conducts only when the voltage at its anode reaches a preset level. This level is set by the DC bias voltage applied to the gate through R213 and R214. Since the basic free-running frequency of this oscillator depends on the time required for the voltage across C206 to reach the trigger level of Q203, the oscillator frequency is set by the value of R212. This time is set at approximately .7 seconds when Miles Per Hour and Knots are used. The value of R212 is changed to increase the time approximately one second if Kilometers Per Hour is used.

The negative going portion of the display rate clock waveform is coupled through C207 to the input (pins 4 and 5) of inverter IC202B. The output of IC202B (Waveform G) is used to start the wind calibrate monostable (IC203) and to reset the decade counters (IC204 and IC205).

WIND CALIBRATE MONOSTABLE

The period of time that the output (pin 6) of IC203 is high (positive) determines the time that input pulses may be counted by decade counters IC204 and IC205. This positive output pulse is applied to pin 13 of sample gate IC202E, allowing input pulses from IC202D to pass to the decade counters (Waveform J).

At the end of the positive pulse from IC203, the negative going portion is coupled through C212 to the input (pins 1 and 2) of reset gate IC202A (Waveform L). The output of IC202A is a positive pulse (Waveform K), which is used to reset latches IC206 and IC207.

DECADE COUNTER-QUAD LATCHES-DECODER DRIVERS

Decade counter IC204 counts (in binary form) the input pulses from sample gate IC202E. On each tenth count, IC204 sends a pulse to IC205, which counts the "tens" digit. Each time the display rate clock generates a pulse, the decade counters are reset to zero. The number of pulses counted during the period of time allowed by IC203 are applied to quad latches IC206 and IC207.

These latches are used for temporary storage of the binary information from the decade counters. This binary information is transferred to drivers IC208 and IC209 when a positive pulse from IC202A is applied to pins 4 and 13.

IC208 and IC209 decode the total binary count from the memory latches (IC206 and IC207) and switch the elements of V1 to display the count in decimal form.

POWER SUPPLY

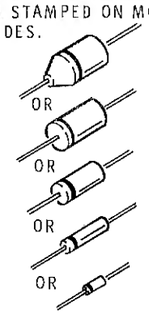
The power supply is comprised of an unregulated high voltage source and a regulated low voltage source.

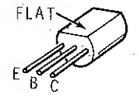
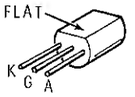
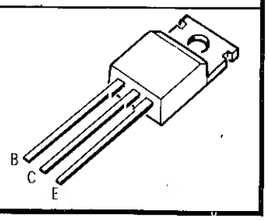
The unregulated high voltage provided by transformer T1 and diodes D201 and D202 is used at the anode of display tube V1.

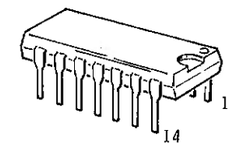
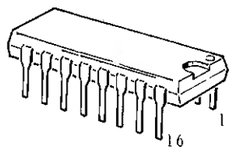
Transistors Q201 and Q202, resistor R202, and zener diode ZD201 regulate the voltage from diode D203 to +5 volts DC. The voltage across ZD201 provides a fixed reference voltage for the base of Q202, whose constant emitter voltage is connected to the base of series-pass transistor Q201. Because the base voltage of Q201 is held constant, a regulated +5 volts DC is maintained at its emitter, even though the input (collector) voltage may vary. Resistor R203 reduces the current through transistor Q201, there by reducing its power dissipation.

Transformer T1 provides an AC signal through resistor R204 that is used to calibrate the wind speed circuitry.

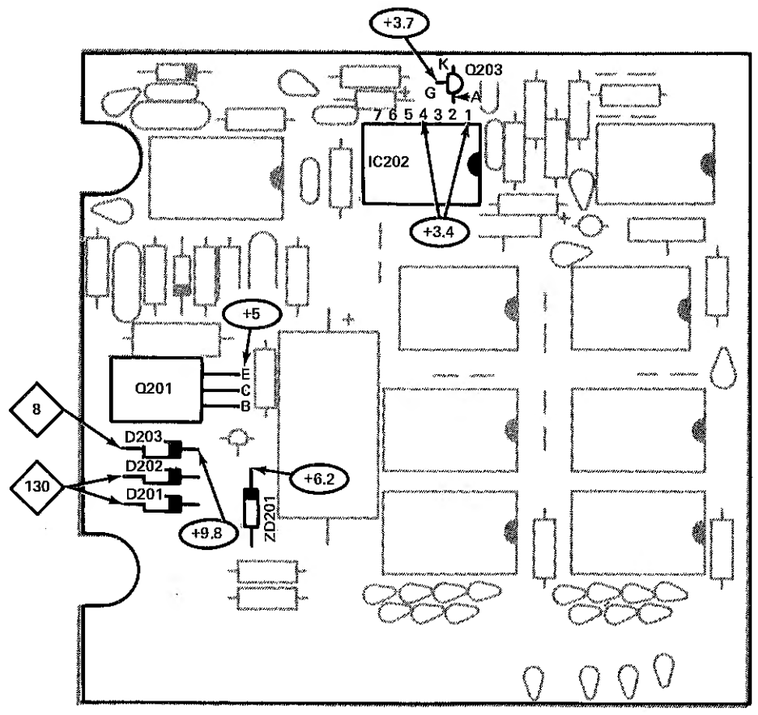
SEMICONDUCTOR IDENTIFICATION CHART

DIODES	HEATH PART NUMBER	MAY BE REPLACED BY	DESCRIPTION	BASING DIAGRAM
ZD201	56-58	IN700A (VIOLET-BLACK -WHITE)	ZENER DIODE 25mA, 6.2V	NOTE: HEATH PART NUMBER ARE STAMPED ON MOST DIODES.
D1, D2, D3, D4, D5, D6, D7, D8, D101, D102, D201, D202, D203, D204, D205.	57-27	IN2071	SILICON RECTIFIER 1A, 600V	

TRANSISTORS	HEATH PART NUMBER	MAY BE REPLACED BY	BASING DIAGRAM
Q202	417-801	MPSA20	
Q203	417-823	MPU131	
Q201	417-852	TIP31	

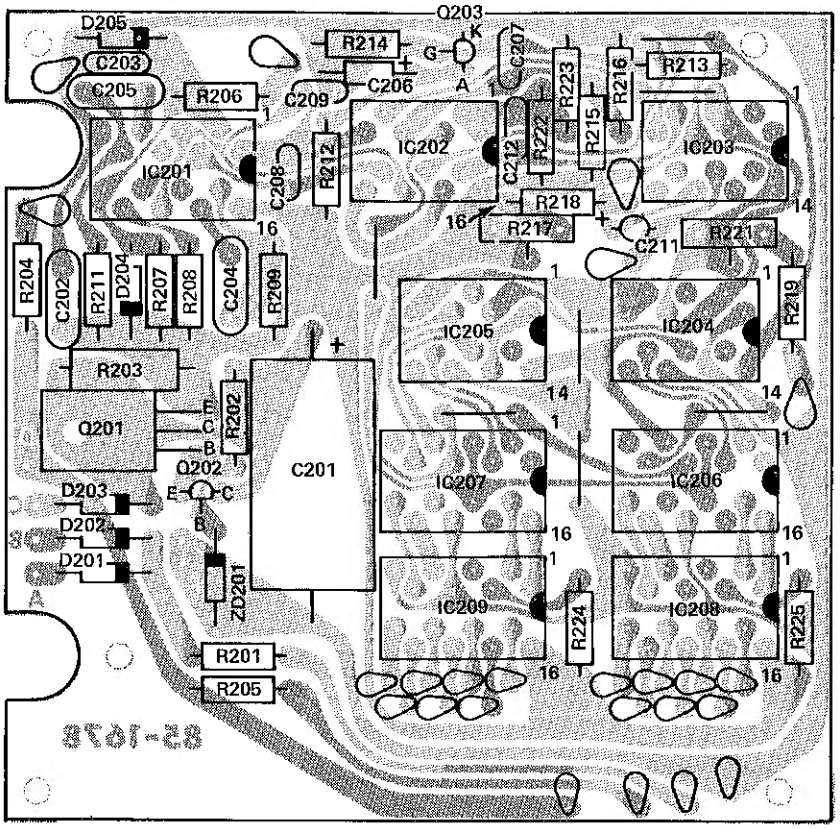
INTEGRATED CIRCUITS	HEATH PART NUMBER	MAY BE REPLACED BY	LEAD CONFIGURATION
IC202	443-1	SN7400N	
IC203	443-22	SN74121N	
IC204, IC205	443-7	SN7490N	
IC201	443-90	SN74123	
IC206, IC207	443-13	SN7475N	
IC208, IC209	443-602	DD700	

CIRCUIT BOARD VOLTAGE CHART

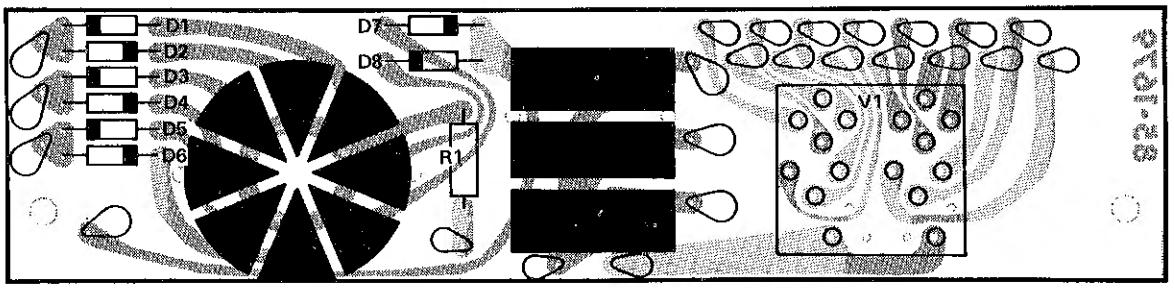


⬭ THIS SYMBOL INDICATES A DC VOLTAGE.

◇ THIS SYMBOL INDICATES AN AC VOLTAGE.



(Viewed from component side)



(Viewed from component side)